

**Abstract for the section ICES302: AIChE – Physio-Chemical Life Support
Process Development at the 43rd International Conference on Environmental
Systems (ICES)**

**Title: Visible Light Responsive Catalysts Using Quantum Dot-Modified TiO₂ for
Air and Water Purification**

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Abstract:

The method of photocatalysis utilizing titanium dioxide, TiO₂, as the catalyst has been widely studied for trace contaminant control for both air and water applications because of its low energy consumption and use of a regenerable catalyst. Titanium dioxide requires ultraviolet light for activation due to its band gap energy of 3.2 eV. Traditionally, Hg-vapor fluorescent light sources are used in PCO reactors and are a setback for the technology for space application due to the possibility of Hg contamination. The development of a visible light responsive (VLR) TiO₂-based catalyst could lead to the use of solar energy in the visible region (~45% of the solar spectrum lies in the visible region; > 400 nm) or highly efficient LEDs (with wavelengths > 400 nm) to make PCO approaches more efficient, economical, and safe. Though VLR catalyst development has been an active area of research for the past two decades, there are few commercially available VLR catalysts; those that are available still have poor activity in the visible region compared to that in the UV region. Thus, this study was aimed at the further development of VLR catalysts by a new method - coupling of quantum dots (QD) of a narrow band gap semiconductor (e.g., CdS, CdSe, PbS, ZnSe, etc.) to the TiO₂ by two preparation methods: 1) photodeposition and 2) mechanical alloying using a high-speed ball mill. A library of catalysts was developed and screened for gas and aqueous phase applications, using ethanol and 4-chlorophenol as the target contaminants, respectively. Both target compounds are well studied in photocatalytic systems serve as model contaminants for this research. Synthesized catalysts were compared in terms of preparation method, type of quantum dots, and dosage of quantum dots.

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Bio:

Janelle Coutts is a Scientist II with Craig Technologies at Kennedy Space Center under the Engineering Services Contract. In 2008, she earned a bachelor's degree in Chemistry at the University of Central Florida in Orlando, and is currently in her 5th year of the Materials Chemistry Ph.D. program at the same university. For the past three years, she has worked as part of the Analytical and Biological Capabilities Lab with the Advanced Life Support Group at KSC, focusing on air revitalization and photocatalytic oxidation of volatile organic compounds. Janelle has also focused on research involving environmental remediation of hazardous chemicals in some of her graduate research with the Industrial Chemistry Lab at UCF, while her main dissertation research focuses on her KSC work.